# Phase-Filter Method of Monitoring a Carrier Frequency

O. Borsuk, A. Bondariev

*Abstract* — **this paper describes the results of monitoring a modified device for tracking objects that move with variable speeds and Doppler shift.**

*Keywords* - **PLL, phase detector, VCO, band width, lead-lag, Matlab.**

## I. INTRODUCTION

In active or passive methods of radiolocation a huge role belongs to a receiver of radio-locating system, that is a monitoring system. It reproduces an input operation that changes by an unknown law. Receivers of such systems are complex devices for signals finishing that use digital and analog methods. The main part of these devices is Demodulator of signals. The demodulator of radio signal extracts useful signal by means of devices used for spectrum transfer without the use of complex filters.

This paper describes the results of monitoring a modified device for tracking objects that move with variable speeds and Doppler shift.

## II. INSTRUCTION FOR AUTHORS

The structural scheme of device is depicted at the sketch 1. Where one can see a PLL device and quad modulator, and additional bandpass filter at the output. Double frequency transfer in the quad modulator weights down parasitic harmonics that appear at the input of the phase detector, and also limit its working area, thus improving its linearity. Bandpass filter removes (eliminates) parasitic harmonics that appear in the result of frequency transfer.

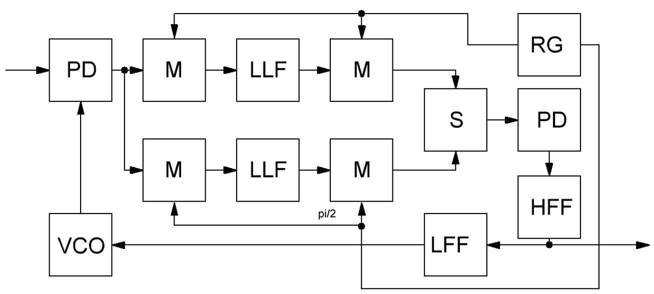


Fig 1 — Structural scheme of a monitoring device (FD – phase detector, M1,M2,M3,M4,M5 – Multipliers, LLF1,LLF2 – lead-lag filter, LFF – low-frequency filter, HFF – high-frequency filter, VCO – voltage controller oscillator, PS– phase shifter, RG – reference generator, C1 - adder).

Having got a simplified model of device by method of linearization, depicted at sketch 2, there was made

O. Borsuk, A. Bondariev - Lviv Polytechnic National University , S. Bandery Str., 12, Lviv, 79013, UKRAINE, E-mail: hawkroot@gmail.com

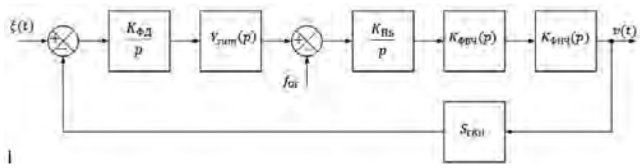


Fig 2. Structural algorithmic model of a monitoring device

an analytical calculation and received the following mathematical system model:

$$V(p)=\frac{K_{ФД}K_{П5}(p)S_{ГКН}(T_1p+1)}{p^2(T_2p+1)}\left[\frac{Kd_{sum\,1}(T_{1,1}p+1)}{(T_{1,2}p+1)p^2}+\frac{Kd_{sum\,2}(T_{2,1}p+1)}{(T_{2,2}p+1)p^2}\right]\Xi(p)$$

This expression means a transmission characteristic of a monitoring device not taking into consideration the influence of disturbing factors.

By means of MATLAB Simulink software and the results of analytical calculation there was built a simulation model of a monitoring device.

As a data signal there was used a harmonic signal, modulated by Doppler shift.

Correlative characteristics of the input and output signals testified that this device reproduces a high-quality signal while the respect of signal/noise is small, even at the edge of band capture.

## III. CONCLUSION

With the help of simulation research we've got the following results: 1) In respect of dynamic properties and filter abilities the system doesn't differ from a classical PLL. 2) Threshold effects that appear due to the huge difference of input signal phases the PD decreased 10 times, which tells of the hindrance imunity increase. 3) There decreased a non-linear distortion at the ФД output. 4) Using BF and HFF it became possible to decrease noise and dynamic errors, that allowed increasing the permissible noise intensity, as well as broadening the monitoring range in 40% 5) With the help of BF and HFF parameters there was achieved an equality of upkeep and capture, under any primary condition.

Thus, there was guaranteed a hindrance imunity increase, bands of upkeep and capture with preservation of system dynamic properties.

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